Head On

LINE ARRAY VERSUS POINT SOURCE

The line array has been the staple speaker configuration of live music and venues for decades, but some are looking at point source systems as an alternative. Shuttlesound's David Howe and Funktion One's Tony Andrews quite literally lock horns...

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Line arrays have actually been around...

lor a lot longer than most people realise; the column loudspeaker found in many traditional English churches is actually a line array, with many of the designs used for these loudspeakers dating back to the 1950s and 60s. In fact the concept of line arrays is mentioned as far back as 1896.

When a group of individual loudspeaker drivers are arranged in a vertical line, we get two very useful benefits. Firstly, the vertical dispersion of the array is more tightly focused than for a single loudspeaker, meaning more sound energy is directed to the audience, which is desirable, and much less to the ceiling and floor, which is not so desirable. Secondly, as the output from all the drivers in a line array should sum coherently, they will give us a much greater acoustic output than the single device.

The problems start however as soon as you put one loudspeaker driver in close proximity to another. Sound is a pressure wave and the wavelength varies between around 12m at 30Hz (one of the lowest frequencies found in most musical material) to just over 2cm at 16kHz (one of the highest most adults can hear). To produce a uniform sound field, the drivers need to be spaced no more than half a wavelength apart. Further apart than this and the array will suffer from lobing, which can be heard as changes to the tonal character of the system as you move around the listening space. For the low frequencies, bass drivers are typically 18" and 15" speakers, so spacing them less than half wavelength is not a problem. Even the mid-range speakers can be spaced close enough to maintain the rule. This ▶

Most sound, including our voices, naturally...

emanates from a single point. The only sound I can think of which emanates from a line, is a stringed instrument. The theoretical propagation pattern of a point is spherical, and an example is the ripples generated by a stone dropped into the pond, although this is only in two dimensions. The pattern from line arrays is more complex. On a sliding scale, lower frequencies and longer wavelengths will couple and tend towards a flat wavcfront. At higher frequencies, where the wavelength dimension is smaller than the spacing of the components in the array the loudspeakers will start behaving as a multitude of small point sources with narrowing dispersion as the frequency rises. This has been the problem with line arrays. This multitude of point sources would be quite acceptable if the components were positioned on the surface of a notional sphere. In a line array they are positioned almost on a Hat plane; wherever a listener is positioned in front of a line array most of the loudspeakers can be heard, which sounds like a positive thing except that every loudspeaker is in a different position and therefore a different distance from the listener which spells much trouble. Consider the crack from a snare drum. In a split second it goes from no sound to full on sound. What makes it exciting is its attack or fast transient. When this is heard from a line array the sound from all the differently positioned loudspeakers arrives not all at once but in a closely spaced series of hits which has the effect of smearing or blunting the attack. It is like applying soft focus to a picture. The audible effect of this is a loss of crispness, and the sound retreats into the enclosure. As point source clusters ▶

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is why those old column loudspeakers use small 4" to 6" drivers. The drivers can be spaced close enough to work very well in the speech region frequencies and hence their popularity where speech is the primary objective.

For high volume music reproduction, we need those high frequencies as well though, otherwise the music would sound very dull and lifeless.

This is not quite so simple; in most conventional high powered loudspeaker cabinets, the high frequencies are handled by a compression driver (the loudspeaker driver) bolted to a horn flare which controls the dispersion. If you have ever tried placing two or more compression driver/horn assemblies one on top of the other, you will indeed meet one of the objectives of a line array; there will be an increase in sound pressure output, but, as the horn flare is now physically much larger than the half wavelength spacing, for the vast majority of the frequencies they reproduce the result is very uneven tonal character particularly as you walk between the rear and the front of the venue.

High-power line arrays have really seen an explosion in popularity in the last eight years or so primarily because, until then, manufacturing processes were unable to produce high-frequency elements that could maintain that half wavelength spacing right up into the very high frequencies we need for music. Electro-Voice was one of the first to develop a successful solution to the line array high frequency challenge. All EV line array loudspeaker systems (ranging from the X-Line large format system as heard on many of the world's largest stages, through XLC mid size system and now XLVC very compact systems) incorporate the HydraTM vertical plane-wave generator. The Hydra is an extremely complex piece of engineering, not too dissimilar to a conventional horn flare but incorporating an intricate array of small wave-guides, or tubes for want of a better description, ensuring that the high frequencies can now also deliver a consistent lobe free sound field.

Conventional arrays often require two or three loudspeaker cabinets to be placed side by side to get the same horizontal coverage and in larger venues they may also need to be stacked vertically to get the desired sound pressure levels. This invariably results in a very uneven frequency response as you move around the venue. Modern high power line arrays do provide better, coverage than conventional arrays and, provided the high frequency elements incorporate a device such as EV's HydraTM , this advantage will be maintained over the entire audio frequency range, ensuring every seat in the house will get the same high quality sound. They are a concept which has been around for almost as long as the loudspeaker itself and now we finally have the technology to deliver, they are sure to be with us for quite a few years to come. •

TONY ANDREWS

have their components positioned on a curved surface they cannot point in the same direction so a listener only hears one source at a time, eliminating this multiple arrival problem.

Another problem with line arrays is their fixed horizontal dispersion pattern. If the shape of the room matches the dispersion pattern of the line array then it can be OK so far as coverage is concerned. If the room is on the narrow side and really needs a narrow coverage pattern then sound from a line array will be literally bouncing off the walls, just adding to the problems of smearing and lack of accuracy and image. There are some well known venues on the band touring circuit which are almost unusable with line arrays. A good point source cluster is useable in increments of 20 to 40 degrees to generate any overall coverage pattern which is desired, just by adding smaller coverage patterns together like slices of a pie.

Generally speaking, line arrays are very inefficient, which means they are bad converters of amplifier energy into acoustic output. This means that amplifiers have to be driven hard to achieve the required sound levels which removes headroom and puts strain on the components, not to mention the energy consumption. One of the main reasons for this inefficiency is the use of direct radiators for bass and mid range which rely on mutual coupling for their directivity. The mutual coupling also slightly raises efficiency at lower frequencies. Point source clusters, however, are usually horn loaded to keep the sound in a beam separate from the sound issuing from the other components in the cluster. A huge benefit of horn loading is the vast improvement in connecting the speaker diaphragm to the air. This can be as much as 10dB which is 10 times more sound for the same amplifier energy by adding a correctly developed horn. Another annoying line array problem is that they cannot be used as a single unit. They usually need at least four enclosures to start working properly. Point source enclosures can be used individually, giving them greater flexibility of use.

It is very difficult to achieve a nicely behaved horn or waveguide and even more difficult to achieve a well behaved cluster of them. Compared with this, line arrays are relatively easy to design which is probably why the sound industry has had so many of the miserable things inflicted on it.

The above points are all equally relevant to both live and club applications. The club world has embraced point source sound for its immediacy, clarity and accuracy whereas the live sound market has not moved away from line array. This year sees a potential sea change with a F1 Resolution point source cluster featuring on the main Pyramid Stage at Glastonbury - selected for both its clarity and environmental control over the line arrays of recent years. Lines can now be thought of as 'conventional systems', with developments in sound quality coming from pioneering point source led by Funktion One. •